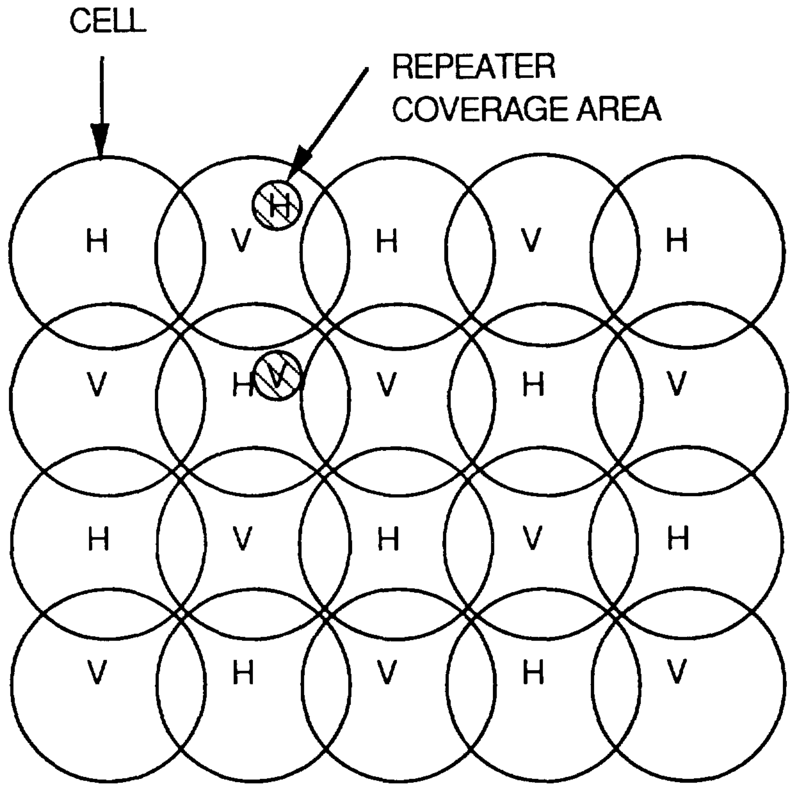
TWTA Saturated Output Power:	100 Watts
TWTA Operating Backoff:	7 dB
Modulation Type:	FM
Number of Channels:	49
Channel Bandwidth:	18 MHz
Channel Spacing:	20 MHz
RF Bandwidth:	1000 MHz
Antenna Gain:	10 dBi
Receiver Characteristics:	
Antenna Size:	3 in. diameter (near transmitter) 25 dBi
	15 in. diameter (cell fringe area) 38 dBi
Noise Figure:	6 dB
Performance Factors:	
Cell Diameter:	7.8 miles (NY)
	12.4 miles (LA)
SNR:	55 dB (clear weather)
	42 dB (rain fade)
Rain Availability:	99.9%
Unavailability in fringe area:	8.76 hours/year

Figure 2-1. LMDS Characteristics



H: Horizontal Polarization
V: Vertical Polarization

Figure 2-2 Cellular Coverage and Polarization Plan

3. Satellite Systems in the 27.5 - 29.5 GHz Band

Users and proposed users of the 27.5 - 30.0 GHz band include several different types of Fixed service and fixed-satellite service systems. These would include VSATs, high data rate FSS uplinks, feeder links to geostationary satellites in other services such as MSS and ISS, and the currently proposed feeder links to MSS(LEO) satellites. Typical transmitting Earth station characteristics for FSS systems are given in Figure 3-1. Typical receiving space station characteristics are given in Figure 3-2.

System	Orbit Long	Long Toler	Frequency Band (MHz)			Station Type	Pe	Gain	Polar	Radiation Pattern
ACTS	-100	0.05	28,970.00	-	29,870.00	LBR	-55.3	55.5	-	App 28
ACTS	-100	0.05	28,970.00	-	29,870.00	NGS	-59.3	60.7	-	App 28
ACTS	-100	0.05	29,974.50	-	29,975.50	CR&T	-43.0	60.8	-	App 28
L-SAT	-19.0	0.1	28,052.00	-	28,700.00	FSS	-36.0	70.0	-	Rec 465
L-SAT	-19.0	0.1	28,052.00	-	28,700.00	FSS	-36.0	70.0	-	Rec 465
ITALSAT	13.0	0.1	28,215.00	-	29,997.00	FSS	-40.0	61.9	-	Rec 465
ITALSAT	13.0	0.1	28,215.00	-	29,997.00	FSS	-40.0	61.9	-	Rec 465
EDRSS		0.1	27,500.00	-	30,000.00	FSS	-40.0	69.0	-	Rec 465
ETS-6-FS	154.0	0.5	27,500.00	-	31,000.00	FSS	-44.0	60.9	-	Rec 465
F-SAT		0.2	29,500.00	-	30,000.00	FSS	-30.0	59.0	-	App 28
CS-2A, 2B CS-3A, 3B		0.1	27,500.00	-	29,000.00	FSS	-40.7	68.9	LHC	Rec 465
SCS-1		0.1	27,570.00	-	29,000.00	FSS	-31.2	61.1	LHC	Rec 465
IRIDIUM	755*	-	29,100.00	-	29,300.00	FSS	-45.4	57.6	-	
ODYSSEY	10,371*	-	29,500.00	-	30,000.00	FSS	-47.0	57.57	-	
SUPERBIRD		0.1	27,570.00	-	29,120.00	FSS	-33.4	61.1	LHC	Rec 465

* Altitude in km (non-geostationary satellite)

Figure 3-1. Transmitting earth station characteristics

System	Orbit Long	Long Toler	Frequency Band (MHz)			Polar	Beam Type	Gain	Ts
ACTS	-100.0	0.05	28,970.00	-	29,870.00	-	East/West	53.1	920
ACTS	-100.0	0.05	28,970.00	-	29,870.00	-	Steerable	43.3	920
ACTS	-100.0	0.05	29,974.50	-	29,975.50	-	Ka CR&T	34.0	3820
L-SAT	-19.0	0.1	28,052.00	-	28,700.00	-	FSS	44.0	630
ITALSAT	13.0	0.1	28,215.00	-	29,997.00	-	FSS	53.0	1300
ITALSAT	13.0	0.1	28,215.00	-	29,997.00	-		53.0	1300
EDRSS		0.1	27,500.00	-	30,000.00	-	FSS	41.0	1585
ETS-6-FS	154.0	0.5	27,500.00	-	31,000.00	-	FSS	52.0	922
CS-2A, 2B CS-3A, 3B		0.1	27,500.00	-	29,000.00	LHC	FSS	39.6	2327
SCS-1		0.1	27,570.00	-	29,000.00	LHC	FSS	49.0	1330
IRIDIUM	755*		29,100.00	-	29,300.00	-	FSS	23.5	1453
ODYSSEY	10,371*		29,500.00	-	30,000.00	-	FSS	32.0	630
SUPERBIRD		0.05	27,570.00	-	29,120.00	LHC	FSS	49.0	1330

* Altitude in km (non-geostationary satellite)

Figure 3-2. Receiving Space Station Characteristics

4. Sharing Between LMDS and the Fixed-satellite service

Three different sharing situations exist between the LMDS and fixed-satellite services. These include sharing between the LMDS and FSS power control beacons, sharing between FSS earth stations and LMDS receivers and sharing between LMDS transmitters and FSS satellite receivers. These are discussed in the following sections.

4.1 Interference between LMDS and FSS power control beacons

For many FSS systems, uplink power control systems will be required to achieve uplink availability and performance standards. To accomplish this, the uplink Earth station will monitor a narrow-band downlink beacon from the satellite. WARC-92 allocated two 1 MHz wide bands, 27.500 - 27.501 GHz and 29.999 - 30.000 GHz for this purpose. The effective use of the lower half of the 27.5 - 30.0 GHz FSS band depends on beacons operating at the 27.500 - 27.501 GHz frequency. RR882A restricts the eirp of such beacons towards adjacent geostationary satellites to 10 dBW, which essentially limits the power delivered to the antenna to about 10 to 15 dBW. Power control beacon signals could be expected from every FSS satellite in orbit.

The effect of FSS beacon signals on co-frequency LMDS receivers will vary depending upon the number of satellite beacon downlinks into the LMDS service area, the satellite eirp and the bandwidth of the LMDS signals. The interference-to-noise ratio in an LMDS receiver, using the characteristics of the ACTS satellite beacon is calculated as follows:

Power delivered to the antenna	-10.0 dBW
Gain of the transmitting antenna	29.7 dBi
Loss, spreading	-163.0 dB/m^2
Area of an isotrope	-50.2 dBm^2
Gain of the receiving antenna	38.0 dBi
Interference received	-155.5 dBW
Boltzmann's constant	- 228.6 dBJ/K
Receiver noise temperature (870K)	-29.4 dBK
Bandwidth (18 MHz)	-72.6 dB Hz
I/N	-28.9 dB

This calculation assumes that the interference enters the LMDS subscriber through its mainbeam. While the effect on an 18 MHz FM-TV signal receiver would be minimal, the effect on a co-frequency narrow band signal could be considerably greater. LMDS licensees should be aware of these downlinks when planning their systems.

Frequency coordination will also be required between FSS power control beacon receiving Earth stations and LMDS transmitters. The receiving Earth station, however, will not have any flexibility in frequency selection because the primary allocation for the service is only 1 MHz wide and the satellite will have only one beacon signal. They will have very little flexibility with regard to location, because they will be operating in conjunction with an uplink Earth station that must be coordinated with systems operating in a different portion of Ka-band. For these reasons, FSS power control beacon earth stations would have extreme difficulty in changing any of its operational parameters as part of a coordination.

If LMDS systems are permitted in the lower portion of the 27.5 - 29.5 GHz band, protection must be provided to FSS power control beacon earth stations operating in accordance with RR882A.

In addition, it should be noted that NASA will operate the Advanced Communications Technology Satellite, ACTS, which is expected to be launched in July, 1993. ACTS has a propagation beacon downlink at 27.505 GHz, operating in the secondary allocation provided for this purpose. The ACTS beacon should have no effect on LMDS systems using 18 MHz FM-TV signals. It could, however, effect narrower signals, on the order of 56 kHz, which are described in the Sarnoff report for the "future development of secondary services."

The ACTS beacon could affect a 56 MHz, or narrower, signal implemented in the LMDS base-to-subscriber direction if they are co-frequency, the subscriber antenna is pointed directly at the ACTS satellite and the LMDS signal does not have any excess margin. The Sarnoff report describes the "future development of secondary services" that could include narrow-band telephone and data services.

4.2 Interference from FSS Earth stations into LMDS receivers

The urban areas that are desirable for LMDS systems are the same areas that are desirable for FSS, particularly for VSAT terminals which are ideal for the Ka-band. LMDS users could well be located literally across the street from a VSAT terminal users, perhaps even in the same building. Considering that the eirp of a VSAT Earth station in the horizontal plane will be about 11 dBW in 18 MHz while the LMDS base station transmitter eirp will be about 5 dBW in 18 MHz, such a proximity of LMDS subscribers and FSS Earth stations would make sharing extremely difficult, if not impossible.

§21.1002(b) of the proposed rules states that licensees shall coordinate with existing users within 75 miles of an LMDS base station in order to resolve any interference problems. The Appendix 28 coordination distance for a transmitting ACTS earth station is the minimum 100 km, assuming a 25° elevation angle. This compares directly with the 75 mile coordination distance proposed in the NPRM. Other, higher powered earth stations could have coordiantion distances up to 280 km (175 miles).

It is difficult to see on what basis coordination between an FSS Earth station and an LMDS receiver could be successfully achieved. The methods by which interference problems are addressed, and the applicability of these methods to FSS/LMDS coordination are as follows:

- **Frequency separation.** Under the proposed rules, LMDS systems would operate on virtually all frequencies in the 27.5 - 29.5 GHz band. This would leave only 20% of the allocated non-government FSS bandwidth for use by FSS systems.

- **Antenna off-axis discrimination.** Since an LMDS system could serve individual consumers, the possibility exists for every house or office building in an area to have an LMDS receiving and/or transmitting antenna. This would be particularly true of a CATV type distribution system. Under this scenario sharing through antenna discrimination would be impossible since the subscriber antennas could be located anywhere within the service area.

- **Polarization discrimination.** Polarization discrimination would be virtually non-existent because the coupling between the LMDS antenna and the earth station antenna would occur through a sidelobe or backlobe of the FSS Earth station antenna or the LMDS antenna.

- **Geographical separation.** As stated for the antenna discrimination case above, since subscribers could be located anywhere within a cell, geographical separation is not feasible. The separation distances that would be required are discussed below.

The required geographical separation distance between an LMDS subscriber receiver and an FSS Earth station can be calculated as a function of the location of the FSS Earth station relative to the mainbeam of the LMDS subscriber antenna as was done in the Sarnoff report for interference between LMDS and point-to-point relay systems. For an LMDS subscriber receiving antenna located at the edge of its service area, an FSS Earth station in its backlobe (i.e. about 48° to 180° away from the antennas mainbeam direction, would need to be at least 2.9 km (1.8 miles) away from the subscriber. Near the LMDS antenna mainbeam, the Earth station would have to be over the horizon from the subscriber, a distance larger than a single LMDS cell, so as not to cause interference into the subscriber receiver. This is illustrated in Figure 4.2-1 which shows the required separation distance as a function of azimuth around the LMDS subscriber receiver.

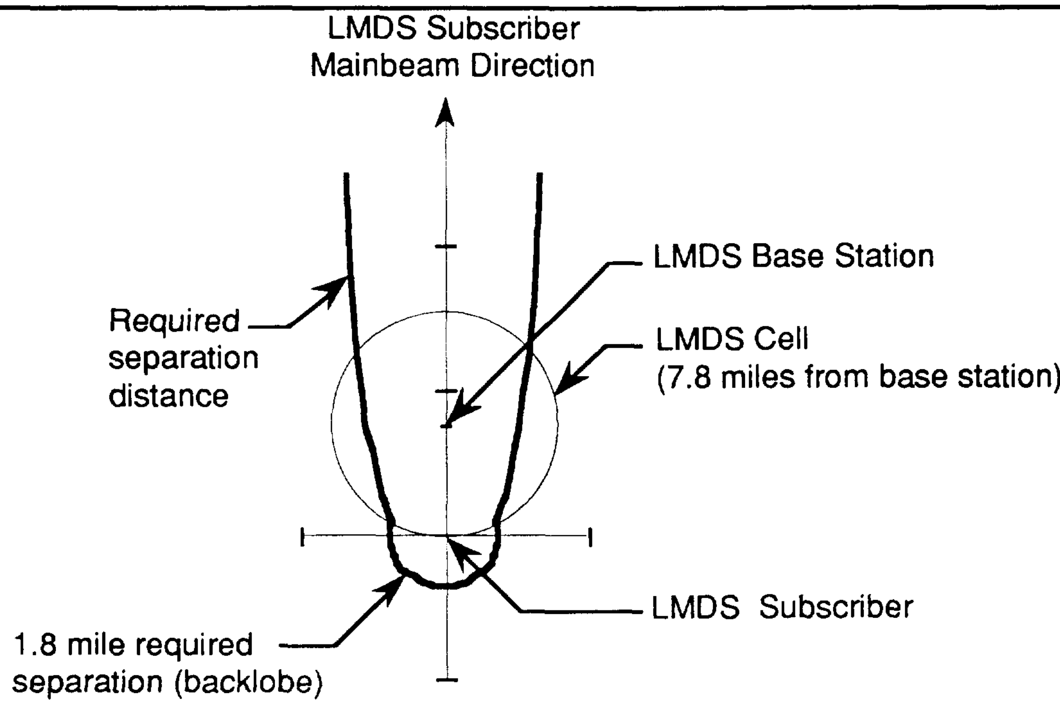


Figure 4.2-1. Required separation distances between an LMDS subscriber and an FSS earth station

As can be seen **single** LMDS subscriber receiver at the edge of its service area would prohibit the location of an earth station almost anywhere within its cell. Since, by the nature of the LMDS, a large number of subscribers are expected in each cell, the area covered by an LMDS cell is virtually unusable by fixed-satellite service Earth stations.

4.3 Interference to ACTS and future FSS satellite receivers

FSS satellites operating in the 27.5 - 29.5 GHz band will receive emissions from terrestrial LMDS transmitters operating co-frequency. The satellites operating in this band will include geostationary satellites such as ACTS and non-geostationary satellites such as Iridium and Odyssey. The characteristics of these satellite receivers used in this portion of the analysis are given in Figure 4.3-1

Based on the 3.5 million square mile area of the continental United States and a cell area of about 20 square miles, up to 175,000 LMDS transmitters could be operating on the same frequency. While it could be expected that the total number of LMDS transmitters in the United States would be less than this number, the actual population cannot be quantified. Within a narrow satellite beam covering an urban area, the population density could reach the value given above. A geostationary satellite antenna beam covering the continental United States would receive the emissions from every operating LMDS transmitter.

SYSTEM	TYPE	Gr dBi	Tr kelvins
ACTS	GEO	53.00	920
ACTS	GEO	43.00	920
EDRSS	GEO	41.00	1585
ACTS-LIKE	GEO	27.00	800
NORSTAR	FEEDER TO GEO	31.00	2000
NORSTAR	USER TO GEO	40.00	2000
IRIDIUM*	FEEDER TO LEO	23.50	1435
ODYSSEY*	FEEDER TO LEO	32.00	630
ODYSSEY*	USER TO LEO	28.40	630

* IRIDIUM - 90° inclination, 7143 km radius
ODYSSEY - 55° inclination, 16,733 km radius

Figure 4.3-1. Satellite Uplink Receiving Characteristics

4.3.1 Interference to geostationary FSS Uplinks

Potential interference to geostationary satellite uplinks is evaluated as follows. It is assumed that LMDS systems uniformly occupy CONUS, 20 square miles per LMDS transmitter. The power density of the LMDS signals is taken to be -77.55 dBW/Hz (-5 dBW averaged over an 18 MHz band). The elevation angle from CONUS to the satellite is assumed to be 30°.

- Calculating the coverage area of the antenna beam in square miles.
  For a CONUS coverage antenna, assume a land area of 3,500,000 sq. miles.
  For a narrower beam, calculate Earth area covered by 3 dB beamwidth at a 30° arrival angle for Gr > 32 dBi.

- Maximum possible number of LMDS transmitting stations in the antenna beam is then given by the coverage area/20 sq. miles (smallest cell size, Maximum density).

- Calculate the aggregate interference power density at the satellite receiver, assuming a 0 dBi gain for the LMDS transmitters. Compare to the thermal noise density at the satellite receiver.

SYSTEM	TYPE	Coverage area in sq. miles	Maximum # of LMDS xmtrs	Aggregate interference dB(W/Hz)	Thermal noise dB(W/Hz)	Io/No dB
ACTS	GEO	121,875	6,094	-200.7	-199.0	-1.7
ACTS	GEO	1,146,241	57,312	-200.9	-199.0	-2.0
EDRSS	GEO	1,760,078	88,004	-201.1	-196.6	-4.5
ACTS-LIKE	GEO	3,500,000	175,000	-212.1	-199.6	-12.5
NORSTAR	Feeder to GEO	3,500,000	175,000	-208.1	-195.6	-12.5
NORSTAR	User to GEO	2,216,000	110,800	-201.1	-195.6	-5.5

Figure 4.3.1-1 Maximum interference to GEO satellite uplinks from LMDS transmitters

As can be seen in Figure 4.3.1-1, the interference to noise density ratios vary over a range from -1.7 to -12.5 dB. An appropriate criteria would appear to be an Io/No of about -10 dB, so that the proposed LMDS system would exceed the criteria by up to 8.3 dB. Uncertainties in this analysis include the average gain of the LMDS antennas towards the FSS satellite and the geographical density of the LMDS transmitters in the satellite's antenna coverage area. These factors would probably tend to decrease the interference received. Additional transmitters in the subscriber-to-base station direction, as discussed in the NPRM and Suite 12 proposal, or operating angles lower than 30° elevation, would increase the level of interference.

4.3.2 Interference to MSS (LEO) Feeder Links

There are also proposals to implement feeder links to low-earth orbit satellites in the mobile-satellite service in Ka-band. The characteristics of these LEOs are quite different from the characteristics of geostationary satellites and the sharing situation is much more complex. This topic requires more in-depth study in order to determine the cumulative effect of LMDS transmitters on co-frequency receiving low-earth orbit satellites.

5. Technical questions concerning LMDS design

5.1 Propagation margins

The design proposed for an LMDS system in the Sarnoff report contains margin for rain attenuation, but does not include any margin for obstructions or multi-path propagation. The Sarnoff report states, without providing any reference, that "Rain depolarization, fade margins, and multi-path are not a problem for short range millimeter wave propagation and reception by antennas that have narrow beamwidths." The NPRM, of course, addresses two-way communications. The subscriber-to-base link involves an omni-directional receiving antenna. Furthermore, a potential alternate propagation path in the base-to-subscriber direction would involve LMDS transmissions from the omni-directional base station reflecting off of a building and being redirected 180° into the mainbeam of an LMDS subscriber. That is, energy emitted from the

LMDS antenna in a northerly direction could be redirected towards the south, interfering with direct southerly emissions.

Another effect that is not addressed, but that would be of particular interest for an LMDS system providing cable TV type services, would be the effects of foliage, such as trees, on reception in residential areas. The effects of all propagation phenomena should be quantified using the appropriate CCIR or other state of the art documentation.

While the design of an LMDS system is up to the operator of the system, if an LMDS system is implemented that is later found to have insufficient margin, any increase in the system power to obtain additional margin would cause a further increase in the interference noise level in satellite receivers operating in the band, further exacerbating a difficult sharing situation.

5.2 Power delivered to the LMDS antenna

According to parameters given in the Sarnoff Report, the power delivered to the antenna of an LMDS system would be 12 dBW. This would appear to exceed the limit given No. 2508 and 2511 of the International Radio Regulations. The reason for this regulation is to protect receiving space stations from terrestrial system sidelobe and backlobe Interference. In this case, the interference level in the space station receiver depends upon the number of terrestrial stations within the coverage area of the satellite and the average of their antenna gains in the direction of the satellite. The application of this regulation is particularly important with respect to the LMDS which uses low gain, low discrimination antennas and plans to deploy tens of thousands of transmitters.

It should also be noted that CCIR Recommendation 406 which provide the basis for the limits in RR2508, states in considering (d) "that it is highly desirable that radio-relay systems should employ highly directional antennas;"

6. Summary

In summary, the following conclusions can be drawn:

- Sharing between FSS earth stations and an LMDS system within the same urban area does not appear to be feasible.
- There is a potential for interference from the cumulative effect of a large number of LMDS transmitters into the receiver of a fixed-satellite.
- Sharing appears to be feasible between LMDS systems and fixed-satellite service power control beacons, provided that LMDS designers are aware of the narrow band signals of the beacons and that protection is given to earth stations receiving the power control beacon.

Appendix 1
Advanced Communications Technology Satellite Characteristics

A. Receiving Space Station

Assigned Frequency:	29.42 GHz
Assigned Bandwidth:	900 MHz
Nominal Longitude:	100°W
Longitude Tolerance:	± 0.05°
Inclination Tolerance:	± 0.5°
Visibility Arc:	135°W-97°W
Service Arc:	100°W-100°W

Class of Emission:	Antenna Pattern:	Gmax (dB)	Pointing Accuracy:	System Noise Temperature: (K)
20M7G7WWT	Scanning Beam	+52.0	± 0.03°	920
20M7G7WWT	Steerable Beam	+43.3	± 0.03°	920
20M7G7WWT	Fixed Beam	+52.7	± 0.03°	920
20M7G7WWT	Scanning Beam	+53.1	± 0.03°	920
20M7G7WWT	Fixed Beam	+52.6	± 0.03°	920
41M5G7WWT	Scanning Beam	+52.0	± 0.03°	920
41M5G7WWT	Steerable Beam	+43.3	± 0.03°	920
41M5G7WWT	Fixed Beam	+52.7	± 0.03°	920
41M5G7WWT	Scanning Beam	+53.1	± 0.03°	920
41M5G7WWT	Fixed Beam	+52.6	± 0.03°	920
83M0G2XWT	Scanning Beam	+52.0	± 0.03°	920
83M0G2XWT	Steerable Beam	+43.3	± 0.03°	920
83M0G2XWT	Fixed Beam	+52.7	± 0.03°	920
83M0G2XWT	Scanning Beam	+53.1	± 0.03°	920
83M0G2XWT	Fixed Beam	+52.6	± 0.03°	920
166MG2XWT	Scanning Beam	+52.0	± 0.03°	920
166MG2XWT	Steerable Beam	+43.3	± 0.03°	920
166MG2XWT	Fixed Beam	+52.7	± 0.03°	920
166MG2XWT	Scanning Beam	+53.1	± 0.03°	920
166MG2XWT	Fixed Beam	+52.6	± 0.03°	920
332MG2XWT	Scanning Beam	+52.0	± 0.03°	920
332MG2XWT	Steerable Beam	+43.3	± 0.03°	920
332MG2XWT	Fixed Beam	+52.7	± 0.03°	920
332MG2XWT	Scanning Beam	+53.1	± 0.03°	920
332MG2XWT	Fixed Beam	+52.6	± 0.03°	920
900MW9WWW	Scanning Beam	+52.0	± 0.03°	920
900MW9WWW	Steerable Beam	+43.3	± 0.03°	920
900MW9WWW	Fixed Beam	+52.7	± 0.03°	920
900MW9WWW	Scanning Beam	+53.1	± 0.03°	920
900MW9WWW	Fixed Beam	+52.6	± 0.03°	920

B. Transmitting Earth Station

Assigned Frequency: 29.42 GHz
Bandwidth: 900 MHz

Class of Emission:	Total Peak Power:	Maximum Power Density:	Isotropic Gain:	Half Power Beamwidth:
	(dBW)	(dBW/Hz)	(dB)	
20M7G7WWT	+14.0	-55.3	+49.1	0.57°
41M5G7WWT	+14.0	-58.3	+49.1	0.57°
83MOG2XWT	+16.0	-59.3	+49.1	0.57°
166MG2XWT	+16.0	-62.3	+49.1	0.57°
332MG2XWT	+16.0	-65.3	+49.1	0.57°
900MW9WWW	+16.0	-70.5	+49.1	0.57°
20M7G7WWT	+14.0	-55.3	+55.5	0.27°
41M5G7WWT	+14.0	-58.3	+55.5	0.27°
83M0G2XWT	+16.0	-59.3	+55.5	0.27°
166MG2XWT	+16.0	-62.3	+55.5	0.27°
166MG2XWT	+16.0	-62.3	+60.7	0.15°
332MG2XWT	+16.0	-65.3	+60.7	0.15°
900MW9WWW	+16.0	-70.5	+60.7	0.15°
20M7G7WWT	+10.0	-59.3	+60.7	0.15°
83M0G2XWT	+16.0	-62.3	+60.7	0.15°
41M5G7WWT	+10.0	-62.3	+60.7	0.15°

Assigned Frequency: 29.975 GHz

Bandwidth: 1 MHz

Class of Emission:	Total Peak Power:	Maximum Power Density:	Isotropic Gain:	Half Power Beamwidth:
	(dBW)	(dBW/Hz)	(dB)	
600KF9DEF	+17	-43.0	+60.7	0.15°

C. Transmitting Space Station

Assigned Frequency: 19.7 GHz
Assigned Bandwidth: 900 MHz

Class of Emission:	Total Peak Power:	Max Power Density:	Antenna Pattern:	Gmax	Pointing Accuracy:
	(dBW)	(dBW/Hz)		(dB)	
83M0G2XWT	+16.6	-58.7	Scanning Beam	+53.2	± 0.03°
166MG2XWT	+16.6	-61.7	Scanning Beam	+53.2	± 0.03°
332MG2XWT	+16.6	-64.7	Scanning Beam	+53.2	± 0.03°
900MW9WWW	+16.6	-69.9	Scanning Beam	+53.2	± 0.03°
900MW9WWW	+16.6	-69.9	Steerable Beam	+46.7	± 0.03°
900MW9WWW	+16.6	-69.9	Fixed Beam	+53.1	± 0.03°
900MW9WWW	+16.6	-69.9	Scanning Beam	+53.1	± 0.03°
900MW9WWW	+16.6	-69.9	Fixed Beam	+52.8	± 0.03°

Assigned frequency: 20.185 GHz

Bandwidth: 1 MHz

Class of Emission:	Total Peak Power:	Max Power Density:	Antenna Pattern:	Gmax	Pointing Accuracy:
	(dBW)	(dBW/Hz)		(dB)	
130KG9DEF	-7.0	-67.0	Fixed Beam	+30.8	± 0.03°

Assigned frequency: 20.195 GHz

Bandwidth: 1 MHz

Class of Emission:	Total Peak Power:	Max Power Density:	Antenna Pattern:	Gmax	Pointing Accuracy:
	(dBW)	(dBW/Hz)		(dB)	
130KG9DEF	-7.0	-67.0	Fixed Beam	+30.4	±0.03°

D. Receiving Earth Station

Assigned Frequency:	19.7 GHz
Bandwidth:	900 MHz
Longitude and Latitude of Site:	Within the service area

Class of Emission:	Isotropic Gain: (dB)	Half Power Beamwidth:	System Noise Temperature: (K)
83M0G2XWT	+45.6	0.86°	977
166MG2XWT	+45.6	0.86°	977
332MG2XWT	+45.6	0.86°	977
900MW9WWW	+45.6	0.86°	977
83M0G2XWT	+52.0	0.41°	977
166MG2XWT	+52.0	0.41°	977
166MG2XWT	+57.2	0.22°	631
332MG2XWT	+57.2	0.22°	631
900MW9WWW	+57.2	0.22°	631

Assigned frequency:	20.185 GHz
Bandwidth:	1 MHz
Longitude and Latitude of Site:`	81W42 41N30

Class of Emission:	Isotropic Gain: (dB)	Half Power Beamwidth:	System Noise Temperature: (K)
130KG9DEF	+45.6	0.86°	977
130KG9DEF	+52.0	0.41°	977
130KG9DEF	+57.2	0.22°	631

Assigned frequency:	20.195 GHz
Bandwidth:	1 MHz
Longitude and Latitude of Site:`	81W42 41N30

Class of Emission:	Isotropic Gain: (dB)	Half Power Beamwidth:	System Noise Temperature: (K)
130KG9DEF	+45.6	0.86°	977
130KG9DEF	+52.0	0.41°	977
130KG9DEF	+57.2	0.22°	631